

Further Notes on Laelaptid Mites Parasitic on Vertebrates A Preliminary Study to the Ethiopian Fauna

by

F. ZUMPT, PH.D., F.R.E.S., and P. M. PATTERSON, B.Sc.

Department of Entomology

The South African Institute for Medical Research, Johannesburg

1. GENERAL REMARKS

The systematics of the mesostigmatic mites parasitic on vertebrates are still in a very unsatisfactory condition. Zumpt (1950a) in his first paper on this group adopted, in general outline, the classification given by Vitzthum in his last comprehensive work (1943) in which he created a large family Laelaptidae containing, as subfamilies, also the Liponyssinae, Dermanyssinae and those groups which live in the respiratory system of various vertebrates.

We believe that this step comes nearer to the natural conditions and is a better fit for practical purposes than to split up this group of mites into several families as is done by some authors. The Laelaptidae as defined by Vitzthum (t.c.) include groups of mites which are non-parasitic and predatory as well as those which have adapted themselves to a more or less advanced parasitic life on lower and higher animals. Those species of the Laelaptidae s.lat. with a highly developed body-sclerotization are, in our opinion, to be regarded as the more primitive forms. To these belong, for instance, many species which live as predators in dung and other decaying matter. Such a group is represented by the genus *Macrocheles*, the females of which show a large sternal-plate, small metasternal plates, a genital plate and a united ventri-anal plate; the dorsal plate covers the whole body. In related genera, the ventral plate may be separated from the anal plate, or large metapodal plates are present, or beside the tritosternum, one or two pairs of jugular plates may be developed. The chelicerae are, according to the predatory mode of life, big, shear-like and provided with strong teeth.

It is interesting to note that many of the females of these genera incline to symphoristic habits on dung-visiting insects. This can be regarded as the first step towards real parasitism. From Dr. Lawrence, Natal Museum, I received two specimens of a *Macrocheles* sp., which were taken on a bat. They are certainly not real parasites but used the bats as a vehicle only, and this finding shows how dung-infesting mites may also become accustomed to vertebrates. The same way was probably chosen by many mites which formerly fed on decaying nest-material and are nowadays normal parasites of

nest-building birds and mammals. All transitions between these two ecological groups are found at present, and it is sometimes extremely difficult, if not impossible, to separate, without ecological studies, the real parasites from non-parasitic and symphoristic forms.

Morphology is of no help in this problem. The genus *Hypoaspis*, for instance, contains a great number of species which are non-parasitic, but there are also blood- or lymph-sucking forms which have generally been placed in the subgenus *Haemolaelaps*. Strandtmann (1949) separated this group as a distinct genus from the other subgenera of *Hypoaspis* but we are not convinced that the features given by him justify a generic distinction. A subgeneric classification of the *Hypoaspis* species is still wanting and can only be done after a close study of a great number of parasitic and non-parasitic forms from many countries. We lack the necessary material and, for the present and for urgent practical work, place all forms of *Hypoaspis* regularly found on animals or in their nests, into the subgenus *Haemolaelaps*.

Zumpt (1950a) also regarded *Androlaelaps* as a subgenus of *Hypoaspis*. We are now following other authors and list it as a distinct genus. The South African species are, as our own experiments have proved, real lymph- and blood-sucking parasites.

A genus which most probably does not contain real parasitic forms but which is included in our paper is *Eulaelaps*. The members of this genus are regularly and exclusively found in the nests of rodents and swallows, but the question of feeding is still open. The same is true of several Ethiopian genera of the Hypoaspidinae and Laelaptinae.

In any case, Laelaptid mites which are regularly associated with vertebrates are regarded as parasites and included in our paper. They have also been listed by Radford (1950) in his paper "The mites (Acarina) parasitic on mammals, birds and reptiles."

The parasitic Laelaptidae are, in the present paper, divided into eleven subfamilies, of which the Dasyponyssinae (da Fonseca, 1940) are not known to us and, therefore, not included in the key. *It must be mentioned that our classification of the Laelaptidae is based on the female sex only, the males being very often not known.*

Taking into consideration that a highly developed sclerotization in the female sex is to be regarded as a primitive feature, the newly erected Myonyssoidinae must be looked upon as the most primitive sub-family containing parasitic Laelaptidae. In their general morphology the two known *Myonyssoides* species are very similar to the genus *Macrocheles*, but the sternal and metasternal plates are united and the forelegs are not strikingly thin and have fully developed claws and pulvilli.

In the Laelaptinae, the sternal plate is always separated from the metasternal plate which is reduced to two lateral platelets. Genital and ventral plates are fused forming a genito-ventral plate which shows at least three setae. In this group we already see a progressing adaptation to a parasitic life. The species of the genus *Laelaps*, for instance, are hardly able to extend the body while feeding because the sclerotization is too strong and too extensive, whereas *Radfordiuelaps*, with its strongly reduced genital

plate, is much better adapted for a parasitic life which involves the taking of relatively large quantities of liquid.

It is doubtful if the Laelaptinae represent a monophyletic group and it is quite possible that some of the genera keyed out below may have evolved from different non-parasitic genera. This fact becomes evident in the next family of Hypoaspidae. As already mentioned, the species of the subgenus *Haemolaelaps* may be derived from non-parasitic subgenera of the genus *Hypoaspis*, whereas other Hypoaspidae may be traced back to Laelaptinae with strongly reduced genital plates, as for instance *Radfordilaelaps*. In all Hypoaspidae the ventral plate is so much reduced that, if present at all, it bears no setae.

Somewhat outstanding are the Haemogamasinae in which the body-hairs became extremely short and thin but they are apparently secondary and increased in numbers on the sternum as well as on the genito-ventral plate. This subfamily has been restricted by us to species with features as given in the key II below.

The three subfamilies, Laelaptinae, Hypoaspidae and Haemogamasinae, are still primitive as regards the structure of the chelicerae which are quite strong, always shear-like and provided with teeth and usually with one or more setae on the digitus fixus. They are, furthermore, at most ectoparasitic and never endoparasitic.

The groups next discussed are more advanced in respect of the parasitic mode of life having the chelicerae better adapted for piercing the skin and the body sclerotization more reduced so that the idiosoma can be more extended during sucking lymph or, more commonly, blood. The following three subfamilies may be divided into two further groups which, perhaps, have a different phylogenetic value. The first has the tritosternum bipartite diverging into two hairlike branches. To this group belong the Liponyssinae and the Dermanyssinae which may be easily derived from Hypoaspidae-like ancestors.

A monograph of the Liponyssinae is given by da Fonseca (1948) who regarded it as a distinct family and named it according to Oudemans MacroNyssidae. Da Fonseca (t.c.) himself states that the reasons for dropping Vitzthum's Liponyssinae in favour of Oudemans' name "are not very clear." We prefer the older name which is generally used in medicine and applied entomology; furthermore, the supergeneric names are not dependent of the regulations of nomenclature; so that in any case the change of this old and generally used name should be avoided.

Da Fonseca (1948) has erected a large number of genera without taking into consideration that there is a considerable degree of variability in many species. Zumpt (1950 b, c) found that, for instance, in *Liponyssus forsythi* Zpt. some specimens are, according to da Fonseca's key, to be placed in *Bdellonyssus*, others in *Chiroptonyssus*. The same is true of *Lepronyssoides transvaalensis* Zpt. which is intermediate between *Lepronyssoides* and *Hirstesia*. We, therefore, suppressed a number of genera taken as valid by this author.

The Dermanyssidae are, in general appearance, very similar to certain Liponyssinae, but the chelicerae are needle-like and still better adapted for piercing the skin.

The second group contains several subfamilies in which the tritosternum is wanting or at least, as in some Entonyssinae reduced to a small longitudinal plate. They are all highly specialized parasites with a pronounced specificity for certain groups of vertebrate hosts. Here are to be placed the Raillietinae in the outer ears of Bovidae, the Entonyssinae in the air-sacs of snakes, the Halarachinae in the respiratory systems of various mammals and the Rhinonyssinae in the respiratory systems of birds.

The last-named subfamily is, in general appearance, somewhat similar to the Spinturnicidae which are exclusively ectoparasites of bats. In 1922 Vitzthum united the Rhinonyssinae with the Spinturnicidae, but in his last comprehensive work (1943) he transferred the Rhinonyssinae to the Laelaptidae and restricted the Spinturnicidae to certain bat-infesting mites which have the tritosternum plate-like and the enlarged coxae immovably fixed.

We believe that the shape of the tritosternum is an important feature. The Laelaptidae have a bipartite one, the Spinturnicidae retain the more primitive form in the shape of a transverse plate. The Spinturnicidae are therefore to be regarded as a distinct family compared with the Laelaptidae. But in both families there is a tendency for the tritosternum to be reduced in adaptation to a more advanced mode of parasitic life. The endoparasitic subfamilies of Laelaptidae belonging to the second group mentioned above have lost the tritosternum, and it is also wanting, for instance, in the genus *Periglischrus* of the Spinturnicidae.

The question is now, are all the above mentioned endoparasitic subfamilies of Laelaptidae with the tritosternum wanting really to be derived from more primitive Laelaptidae with a bipartite tritosternum? It certainly is true of the Entonyssinae and Halarachninae. *Entonyssus americana* Turk (1947, Fig. 2) for instance, has a small longitudinal plate which may be interpreted as the remaining foot of a former bipartite tritosternum, and also the other features of this subfamily may be more easily derived from the Laelaptidae than from the Spinturnicidae. In the Rhinonyssinae, however, no species is known which shows a tritosternum whereas their general appearance reminds one of the Spinturnicidae. The only distinguishing feature of any importance is the enlarged and immovable coxa in the Spinturnicidae, but can this not be an adaptation to its special life on the patagium of the bat-wing? These mites are forced to attach themselves very intensively to the nearly hairless skin of the wings. The question of the phylogeny of the Rhinonyssinae cannot be solved at present and, for the time being, we follow Vitzthum (1943) and treat this group as a subfamily of the Laelaptidae.

Apart from the Spinturnicidae and Laelaptidae there are, according to Vitzthum (1943), still two families in the Gamasides parasitic on vertebrates: Ixodorhynchidae and Spelaeorhynchidae. The last named live on South American bats and are very peculiar and primitive, they are placed by Zumpt (1951a) near the root of the *Mesostigmata* and Ixodoidea. The Ixodorhynchidae, ectoparasites of American snakes, are treated by Vitzthum

(1943) as a distinct family, but further investigations may prove that they should be regarded as a further subfamily of the Laelaptidae.

II. KEY TO THE SUBFAMILIES OF LAELAPTIDAE PARASITIC ON VERTEBRATES*

(females only)

- 1 (8) Chelicerae of a generalized type having the tips incurved and being provided with teeth, the fixed arm usually bearing one or even several setae near the tip. Body usually covered with sclerotized plates; tritosternum always present and bipartite. Mode of life ectoparasitic only 2
- 2 (3) Venter with a sterni-metasternal plate which is provided with 4 pairs of setae, and a ventri-anal plate covers the whole opisthosoma and nearly touches the genital plate.
 1. **Myonyssoidinae**
 - 3 (2) Venter with a separate sternal plate, metasternal plate reduced to two small lateral platelets; anal plate mostly free and small, rarely fused with a genito-ventral plate (cf. *Ugandolaelaps*) 4
 - 4 (7) Sternal plate with three pairs of setae or less 5
 - 5 (6) Genito-ventral plate with three or more setae.
 2. **Laelaptinae**
 - 6 (5) Genito-ventral plate more or less reduced, only the basal pair of genital setae present.
 3. **Hypoaspidae**
 - 7 (4) Sternal plate with more than 3 pairs, usually numerous, of setae. Epistome strikingly protruding, the sides denticulated or fringed. Body densely beset with short and fine hairs.
 4. **Haemogamasinae**
 - 8 (1) Chelicerae modified, without teeth and fixed arm without seta. Body usually only partly covered both above and below with sclerotized plates; tritosternum present, bipartite or plate-like, or wanting. Mode of life ectoparasitic, or endoparasitic in the respiratory system 9
 - 9 (12) Tritosternum bipartite and always present 10
 - 10 (11) Chelicerae shear-like, with both arms present.
 5. **Liponyssinae**
 - 11 (10) Chelicerae long and needle-like, one arm reduced.
 6. **Dermanyssinae**
 - 12 (9) Tritosternum wanting, sometimes a small longitudinal plate present 13
 - 13 (18) Peritreme situated laterally 14
 - 14 (17) Anal plate present. Abdomen never vermiform 15
 - 15 (16) Chelicerae shear-like. Living in the outer ears of Bovidae.
 7. **Raillietiinae**
 - 16 (15) Chelicerae with the movable arm sickle-shaped, fixed arm sickle-shaped too, or harpoon-like, or wanting. Living in the air-sacs of snakes.
 8. **Entonyssinae**
 - 17 (14) Anal plate wanting or very greatly reduced. Abdomen frequently drawn out, sometimes vermiform. Living in the respiratory system of mammals.
 9. **Halarachninae**
 - 18 (13) Peritremata situated dorsally. Living in the respiratory system of birds.
 10. **Rhinonyssinae**

* The South American family of Dasyponyssidae da Fonseca (1940) is not included, the literature being unobtainable in this country. It, probably, represents a distinct family.

III. KEYS TO THE PARASITIC GENERA OF LAELAPTIDAE WITH SPECIAL REFERENCE TO THE ETHIOPIAN FAUNA *

1. Myonyssoidinae

Only one genus *Myonyssoides* Hirst (1925) with two Ethiopian species:

- 1 (2) Bigger and more elongated species. First coxa with a squarish posterior spine. Length of idiosoma 0.93 mm. — CAPE PROVINCE, on *Cryptomys hottentotus* Lesson.
capensis Hirst, 1925
- 2 (1) Smaller and stouter species. First coxa with a peg-like pointed posterior spine. Length of idiosoma: 0.76-0.86 mm. — NATAL, CAPE PROVINCE, on *Amblysomus hottentotus* Smith.
spinosus De Meillon & Lavoipierre, 1944

2. Laelaptinae

The following genera are known to us :

- 1 (4) Genito-ventral plate with many, more than 6 pairs, of setae 2
 - 2 (3) Genito-ventral plate strongly enlarged, more or less reaching the anal plate, which is broader than long, outer metapodal plate very big and triangular. — Holarctic Region.
Eulaelaps Berlese, 1903
 - 3 (2) Genito-ventral plate smaller, of normal shape, separated by a wide interstice from the anal plate which is longer than broad, metapodal plates wanting or quite indistinct. — N. AMERICA.
Euhaemogamasus Ewing, 1933
 - 4 (1) Genito-ventral plate with no more than 6 pairs of setae 5
 - 5 (8) Genito-ventral plate with 11 setae 6
 - 6 (7) Sternal plate fully developed, with 3 pairs of setae. — AFRICA.
Spinolaelaps Radford, 1940
 - 7 (6) Sternal plate reduced, front margin indefinite; with only the middle pair of sternal setae. — N. AMERICA.
Sternolaelaps nov. gen.
 - 8 (5) Genito-ventral plate of female with 5 pairs of setae or less 9
 - 9 (12) Genito-ventral plate of female with 5 pairs of setae 10
 - 10 (11) Anal plate of female much enlarged, twice as broad as long. — Holarctic Region.
Myonyssus Tiraboschi, 1904
(syn.: *Tetragnonyssus* Ewing, 1923)
 - 11 (10) Anal plate small, longer than broad. — AUSTRALIA.
Heterolaelaps Hirst, 1926
 - 12 (9) Genito-ventral plate of female with 4 pairs of setae or less 13
 - 13 (16) Genito-ventral plate of female with 4 pairs of setae 14
 - 14 (15) Body very long, first and second pairs of legs much enlarged and spined. — MALAYA.
Longolaelaps Vitzthum, 1926
 - 15 (14) Body of usual shape; first and second pairs of legs not strikingly enlarged. — WORLDWIDE.
Laelaps Koch, 1842
- (Including, perhaps, as subgenera:
Eugynolaelaps Berlese, 1918; *Tricholaelaps* Vitzthum, 1926; *Echino-*
laelaps Ewing, 1929; *Macrolaelaps* Ewing, 1929; *Mysolaelaps* Fonseca,
1937.)
- 16 (13) Genito-ventral plate with less than 4 pairs of setae 17
 - 17 (22) Genito-ventral plate with 3 pairs of setae 18
 - 18 (19) Body oval or egg-shaped, longer than broad; peritreme greatly enlarged. — Indo-Malaya Region.
Neolaelaps Hirst, 1926

* All keys in this paper are based on females only.

- 19 (18) Body subcircular or discoidal, peritremea not greatly enlarged 20
 20 (21) Sternal plate longer than broad. — AUSTRALIA REGION.
Mesolaelaps Hirst, 1926
 21 (20) Sternal plate broader than long. — MADAGASCAR.
Geneiadolaelaps Ewing, 1929
 22 (17) Genito-ventral plate with 3 single setae, triangularly arranged. —
 AFRICA.

Radfordilaelaps Zumpt, 1950

Only four genera are known to occur in the Ethiopian and Madagascan Region, three of which are monotypic. A key to the Ethiopian species of the genus *Laelaps* is given by Zumpt (1951b).

3. Hypoaspidae *

- 1 (18) Dorsal shield undivided 2
 2 (3) Genital and anal plate fused, thus forming a genito-ventri-anal plate, but provided with only one pair of setae at the base beside the usual setae around the anal opening. — AFRICA.
Ugandolaelaps Radford, 1942
 3 (2) Genital and anal plate widely separated 4
 4 (11) Some of the coxae armed with tooth-like posterior spines instead of setae 5
 5 (8) Spines of coxae bifid 6
 6 (7) Coxae I-III with bifid spines. — MALAYA.
Ophidilaelaps Radford, 1947
 7 (6) Coxae I and II with bifid spines. — S. AMERICA.
Neoparalaelaps Fonseca, 1935
 (syn: *Paralaelaps* Fonseca, 1932)
 8 (5) Spines of coxae simple 9
 9 (10) Larger species, about 1½-2 mm. Posterior seta of coxa II strikingly longer than the others. Body more or less oval. — S. AMERICA.
Gigantolaelaps Fonseca, 1939
 10 (9) Smaller species, not reaching 1 mm. Posterior seta of coxa II not strikingly longer than the others. Body almost circular. — N. AMERICA.
Cyclolaelaps Ewing, 1933
 11 (4) Coxae without posterior toothlike spines, with the usual setae only . . 12
 12 (13) Mouthparts greatly enlarged, plates of the body and legs with two kinds of very distinct reticulation. — AFRICA.
Davisiella nov. gen.
 13 (12) Mouthparts of normal size, body plates only with one kind of a more or less distinct reticulation, legs smooth 14
 14 (15) Labium with a membranous expansion, bearing stout setae with slightly expanded extremities. — S. AMERICA.
Bolvilaelaps Fonseca, 1940
 15 (14) Labium of normal shape, not expanded 16
 16 (17) Femora calcarate. — Holarctic and Ethiopian Region.

Androlaelaps Berlese, 1903

* Fox (1946) described a new genus *Borinquolaelaps* with three new species from domestic rats and mice in Puerto Rico. We strongly doubt if these species are parasitic at all, most probably their occurrence on the rodents was accidental. The three species, furthermore, certainly do not belong to one genus but at least to two. We therefore have ignored this paper like Radford (1950) in his second edition of "Mites parasitic on vertebrates".

- 17 (16) Femora not calcarate, with hairs or spines only. — WORLDWIDE.
(*Hypoaspis* subg.?) *Haemolaelaps* Berlese, 1910
(syn: *Atricholaelaps* Ewing, 1929; *Eubrachylaelaps* Ewing, 1929; *Macrolaelaps* Ewing, 1933, nec. 1929; *Ischnolaelaps* Fonseca, 1937; *Cavilaelaps* Fonseca, 1937).
- 18 (1) Dorsal shield divided (cf. Radford, 1942, fig. 3).
Sternal plate about $1\frac{1}{2}$ as long as broad, genital plate strongly reduced, very narrow and short. Length of idiosoma: 1.2 mm. —
UGANDA, off *Mungos mungo* Thomas.

Mungosicola Radford, 1942

Five of these genera occur in the Ethiopian Region: *Ugandolaelaps* Radford, *Davisiella* nov. gen., *Mungosicola* Radford, *Androlaelaps* Berlese and *Hypoaspis* subg. *Haemolaelaps* Berlese. The first three are monotypic, *Haemolaelaps* and *Androlaelaps* are represented in this region. A key to the Ethiopian species of *Androlaelaps* is given by Zumpt and Patterson (1950). Unfortunately they overlooked two species namely *A.oudemansi* and *A.arvicanthis* which were described by Radford in 1944. These two species were both taken from an *Arvicanthis abyssinicus* Rueppell, in Uganda. It is possible that they are conspecific but identical with one of the species listed in their paper.

According to Radford (1950) the following *Haemolaelaps* species have been described from the Ethiopian Region. The genera *Atricholaelaps* Ewing (1929) and *Ischnolaelaps* Fonseca (1937) are to be regarded as synonyms of *Haemolaelaps* (cf. Strandtmann, 1949).

- | | |
|--------------------------------------|---|
| <i>arvicanthis</i> Radford (1939) | <i>dasymys</i> Radford (1939) |
| <i>bathyergus</i> Radford (1939) | * <i>inops</i> Berlese (1911) |
| * <i>calosus</i> Berlese (1916) | <i>lophuromius</i> Radford (1939) |
| <i>capensis</i> Hirst (1916) | <i>megaventralis</i> Strandtmann (1947) |
| * <i>centrocarpus</i> Berlese (1911) | <i>mesopicos</i> Radford (1942) |
| <i>cryptomius</i> Radford (1939) | * <i>murinus</i> Berlese (1911) |
| <i>mystromys</i> Radford (1942) | <i>tateronis</i> Radford (1939) |
| <i>rhabdomys</i> Radford (1939) | <i>villosissimus</i> Berlese (1918) |
| * <i>spinatarsus</i> Berlese (1918) | <i>zulu</i> Berlese (1918) |
| <i>tachyoryctes</i> Radford (1941) | |

The species known to us are listed in the following key:—

- 1 (20) Smaller species, idiosoma not exceeding 0.7 mm. in length 2
- 2 (3) Sternal plate as broad as long (cf. Radford, 1939, fig. 1).
A compact, short oval species. Genital plate bordered by 3 pairs of hairs, no further ones between it and the anal plate; interstice between genital and anal plate narrow. Length of idiosoma: 0.6 mm. — UGANDA, on *Lophuromys aquilus* True.
lophuromius Radford, 1939
- 3 (2) Sternal plate broader than long 4
- 4 (11) Genital plate bordered by 2 pairs of hairs 5
- 5 (8) One pair of hairs between genital and anal plates 6
- 6 (7) Genital plate broader; anal plate as broad as long (Fig. 2).
Very similar to *rhabdomys* from which it is separated by 2 pairs of hairs bordering the genital plate, and by slender outer metapodal plates. Length of idiosoma: 0.53-0.7 mm. — TRANSVAAL and NATAL, on *Rhabdomys pumilio* Sparrm. One record from *Rattus rattus* L. is probably due to contamination *eos* n. sp.
- 7 (6) Genital plate slender, anal plate longer than broad.
Small specimens of *capensis*, cf. 31 (30)
- 8 (5) No hairs distinctly placed between genital and anal plates 9

* These species are not recognizable as the descriptions are very short and without any drawings.

- 9 (10) Soft part of venter very sparsely beset with hairs, about 6 pairs only (cf. Radford, 1939, fig. 5).
Genital plate broader than in the following species; outer metapodal plate slender. Length of idiosoma: 0.47 mm. — CAPE PROVINCE, on *Cryptomys* spec. *cryptomys* Radford, 1939
- 10 (9) Soft part of venter more densely beset with hairs, about 10 pairs (cf. Radford, 1939, fig. 4).
Genital plate less broad than in the foregoing species, outer metapodal plate similarly shaped. Length of idiosoma: 0.53 mm. — UGANDA, on *Tatera benvenuta* Hirst & Kersh.
tateronts Radford, 1939
- 11 (4) Genital plate bordered by 3 pairs of hairs 12
- 12 (13) One pair of hairs between genital and anal plates (cf. Radford, 1939, fig. 6)
Separated from *eos* by the number of hairs bordering the genital plate and by larger outer metapodal plates. Length of idiosoma: 0.6-0.7 mm. — TRANSVAAL, on *Rhabdomys pumilio* Sparrm.
rhabdomys Radford, 1939
- 13 (12) No hairs distinctly placed between genital and anal plates 14
- 14 (15) Venter with only one pair of distinct metapodal plates near the edge of the genital plate (cf. Radford, 1941, fig. 3).
Second pair of hairs bordering the genital plate further from its margin than the two other ones; remaining part of the venter sparsely haired. Length of idiosoma: 0.55 mm. — KENYA, on *Tachyoryctes ruddi* Thomas *tachyoryctes* Radford, 1941
- 15 (14) Venter with three pairs of metapodal plates, the outer one always distinct 16
- 16 (17) Sternal plate about twice as broad as long (cf. Radford, 1939, fig. 8).
Outer metapodal plate short. Length of idiosoma: 0.47 mm. — CAPE PROVINCE, on *Bathergus suillus* Schreber.
bathergus Radford, 1939
- 17 (16) Sternal plate only a little broader than long 18
- 18 (19) Outer metapodal plate long and line-shaped (fig. 3).
Genital plate not or only a little expanded posteriorly. Length of idiosoma: 0.6-0.65 mm. — TRANSVAAL, on *Tatera brantsii* Smith.
oliffi n. sp.
- 19 (18) Outer metapodal plate shorter and more or less oval (cf. Strandtmann, 1949, fig. 4).
Genital plate distinctly expanded posteriorly. Length of idiosoma: 0.6-0.7 mm. — SOUTH AFRICA on *Rattus rattus* L., otherwise of worldwide distribution and recorded from various kinds of mammals and birds *megaventrals* Strandtmann, 1937
- 20 (1) Bigger species, idiosoma exceeding 0.7 mm. in length 21
- 21 (22) Genital plate strongly widened posteriorly, greatest transverse diameter more than twice as long as the distance of the genital hairs from each other (fig. 4).
Genital plate bordered by 3 pairs of hairs, no further hairs between it and the anal plate; outer metapodal plates stout, more or less oval. Length of idiosoma: 0.8-1.0 mm. — S. RHODESIA, on *Saccostomus campestris* Peters *rhodesiensis* n. sp.
- 22 (21) Genital plate tongue-shaped, greatest transverse diameter at most $1\frac{1}{2}$ as long as the distance of the genital hairs from each other 23
- 23 (26) Dorsal shield beset with relatively short and dense hairs; genital plate bordered by 4-5 pairs of hairs, more than 2 pairs of hairs between it and the anal plate 24

- 24 (25) Very similar to the following species, but a little bigger and more densely haired. Both species, because of the densely haired body, are easily recognizable among the known Ethiopian *Haemolaelaps*. Length of idiosoma: 0.84-0.94 mm. — TRANSVAAL and S. RHODESIA, on *Tatera brantsii* Smith and *T. schinzi* Noack.

tataeae n. sp.

- 25 (24) Venter less densely haired with 2 transverse rows of hairs between anal and genital plates (fig. 6).

Smaller than the foregoing species. Length of idiosoma: 0.7-0.77 mm. — S. RHODESIA on *Saccostomus campestris* Peters.

villosissimus Berlese, 1918.

- 26 (23) Dorsal shield beset with longer and more sparse hairs; genital plate bordered by at most 3 pairs of hairs, no more than 2 pairs of hairs between it and the anal plate 27

- 27 (28) Genital plate strongly widened posteriorly, greatest transverse diameter $1\frac{1}{2}$ as long as the distance of the genital hairs from each other (fig. 7).

Sternal plate only a little broader than long, genital plate bordered by two pairs of hairs, a third pair placed between it and the anal plate. The posterior part of the dorsal shield with a pair each of lateral, stronger sclerotized platelets. Length of idiosoma: 0.85-1.02 mm. — CAPE PROVINCE, NATAL, TRANSVAAL, taken off *Rattus rattus* L., *Mastomys coucha* Smith and *Otomys tropicalis* Thomas *labuschagnei* n. sp.

- 28 (27) Genital plate not, or only slightly widened posteriorly, greatest transverse diameter less than $1\frac{1}{2}$ as long as the distance of the genital hairs from each other 29

- 29 (32) Only two pairs of hairs bordering the genital plate 30

- 30 (31) Sternal plate $1\frac{1}{2}$ as broad as long, posterior tips pointed; no further hairs between genital and anal plates (?) (cf. Radford, 1942, fig. 3).

Soft part of venter with sparse hairs. Length of idiosoma: 0.97 mm.

— CAPE PROVINCE, on *Mystromys albicaudatus* Smith.

mystromys Radford, 1942

- 31 (30) Sternal plate broader than long, but distinctly less so than in *mystromys*, posterior tips more rounded; one pair of hairs between genital and anal plates (cf. Hirst, 1916, fig. 12).

Genital plate tongue-shaped; rounded to tapering at the tip and not or only very slightly widened behind the genital hairs. Uncovered posterior venter only sparsely haired. Anal plate longer than broad, more or less egg-shaped, but apparently somewhat variable. Length of idiosoma: 0.6-1.0 mm. — CAPE PROVINCE, NATAL, TRANSVAAL, S. RHODESIA and S.W. AFRICA; recorded from *Cryptomys hottentotus* Lesson, *Tatera schinzi* Noack, *Thallomys namaquensis* Smith and *Aethomys chrysopilus* Winton *capensis* Hirst, 1916

- 32 (29) Genital plate bordered by three pairs of hairs 33

- 33 (34) Parasitic on birds. Genital plate relatively narrow, anal plate nearly twice as long as broad (cf. Radford, 1942, fig. 14).

Legs relatively stout, venter on the posterior part with a few very long hairs. Length of idiosoma: 0.85 mm. — UGANDA, off *Mesopicos ruwenzorii* Sharp *mesopicos* Radford, 1942

- 34 (33) Parasites of mammals. Genital plate broader, anal plate almost $1\frac{1}{2}$ as long as broad 35

- 35 (36) Soft part of venter densely haired (cf. Radford, 1939, fig. 3).

Very similar to the following species but, apart from differences in the hair-pattern, with the genital plate less broad. Length of idiosoma: 0.77 mm. — UGANDA, on *Arvicanthis abyssinicus* Kuppel.

arvicanthis Radford, 1939

- 36 (35) Soft part of venter sparsely haired (cf. Radford, 1939, fig. 2).
Genital plate a little broader than in *arvicanthis*. Length of
idiosoma: 0.83 mm. — UGANDA, on *Dasymys helukus* Heller.
dasymys Radford, 1939

4. Haemogamasinae

We restrict this subfamily to two genera having the sternal plate provided with more than the usual 3 pairs of setae:

- 1 (2) Fixed arm of chelicerae with several recurved, fang-like setae. —
S. AMERICA *Acanthochela* Ewing, 1933
2 (1) Fixed arm of chelicerae with but one thick seta. — HOLARCTIC
REGION, AFRICA *Haemogamasus* Berlese, 1889

The genus *Euhaemogamasus* is transferred to the Laelaptinae, and a new genus *Sternolaelaps* is erected for *Euhaemogamasus utahensis* Ewing (1933) which also belongs to the Laelaptinae. The generic features may be taken from the key to the genera given above.

There is only one species, *Haemogamasus liberiensis* Hirst (1916), known from the Ethiopian Region.

5. Liponyssinae

- 1 (2) Dorsal shield with an anterior hook-like projection. — AUSTRALIA ?
Echinonyssus Hirst, 1925
2 (1) Dorsal shield without such a projection 3
3 (4) Female unknown. Claws of tarsi II in the male unpedunculated and
very strong. — S. AMERICA *Kolenationyssus* Fonseca, 1948
4 (3) Claws normal 5
5 (8) Dorsal shield divided 6
6 (7) Opisthosomatal shield minute; sternal plate provided with only two
pairs of hairs. — HOLARCTIC REGION
Ophionyssus Mégnin, 1884
(syn: *Serpenticola* Ewing, 1923)
7 (6) Opisthosomal shield well developed, sternal plate provided with three
pairs of hairs. — WORLDWIDE *Steatonyssus* Kolenati, 1858
(syn: *Ceratomyssus* Ewing, 1923)
8 (5) Dorsal shield undivided 9
9 (10) Sternal plate with only one pair of hairs. — AFRICA.
Manitherionyssus Vitzthum, 1925
(syn: *Manisicola* Lawrence, 1939)
10 (9) Sternal plate with 2-3 pairs of hairs 11
11 (14) Some of the coxae in both sexes provided with tooth-like spines besides
the dorsal one of coxa II 12
12 (13) Coxa I with a posterior tooth alone. — S. AMERICA.
Neotichoronyssus Fonseca, 1941
13 (12) Coxae II and III or II-IV with teeth. — HOLARCTIC REGION,
AFRICA *Hirstionyssus* Fonseca, 1948
14 (11) Coxae devoid of other spines besides the dorsal one of coxa II 15
15 (16) Sternal plate with two large circular structures. — EUROPE,
S. AMERICA, AFRICA *Lepronyssoides* Fonseca, 1941
(syn: *Hirstesia* Fonseca, 1948)
16 (15) Sternal plate devoid of any other structures besides setae and pores 17
17 (18) Genito-ventral plate developed, bearing 3 pairs of setae. —
MADAGASCAR *Liponyssella* Hirst, 1925
18 (17) Genital plate only developed, only bearing one pair of setae. —
WORLDWIDE *Liponyssus* Kolenati, 1858
(syn: *Ichoronyssus* Kolenati, 1858; *Lepronyssus* Kolenati, 1858;

Macronyssus Kolenati, 1858; *Leiognathus* Canestrini, 1885; *Neoliponyssus* Ewing, 1929; *Bdellonyssus* Fonseca, 1941; *Chirotonyssus* Augustson, 1945; *Radfordiella* Fonseca, 1948 and *Fonsecaonyssus* Radford, 1950)

Eight of the Liponyssinae genera have species in the Ethiopian Region. *Ophionyssus* Megnin is an holarctic genus, but one species, *O. natricis* Gerv. (syn: *serpentium* Hirst; *arabicus* Hirst; cf. Camin, 1949) has also been found in S. ARABIA and in the CAPE PROVINCE.

Steatonyssus Kolenati contains, up to date, four Ethiopian species, one of which is new. They may be separated as follows :

- 1 (4) Posterior margin of sternal plate strongly sclerotized, thickened 2
- 2 (3) Second and third coxae each with a short, strong, pointed spur.
Length of idiosoma: 0.63-0.7 mm. — ANGLO-EGYPTIAN
SUDAN, off *Liponycteris nudiventris* Cretzschmar
sudanensis Hirst, 1926
- 3 (2) Second and third coxae without spurs.
Length of idiosom not given. — NYASSALAND, off an elephant
shrew *nyassae* Hirst, 1922
- 4 (1) Posterior margin of sternal plate weakly sclerotized, not thickened 5
- 5 (6) Sternal plate with strong reticulate markings. A few of the hairs at
the posterior end of the body longer than the others (cf. Hirst, 1922,
figs. 21-22).
Length of idiosoma: 0.65 mm. — S. AFRICA, off *Dendropicos*
cardinalis *biscutatus* Hirst, 1922
- 6 (5) Sternal plate smooth. Hairs at posterior end of body not much longer
than the others (fig. 8).
Length of idiosoma: 0.75 mm. — NATAL, off *Miniopterus*
natalensis, Smith *natalensis* n. sp.

Manitherionyssus Vitzthum contains two S. African species, *M. heterotarsus* Vitzthum (1924) and *M. africanus* Lawrence (1939), both off *Smutsia temminckii* Smuts. These two species may still prove to be conspecific.

Hirstionyssus Fonseca contains four valid Ethiopian species which are separable as follows :

- 1 (2) Second coxa with 3 big posterior spines, the outer one surpasses the
sides of the body and is to be seen from the dorsal side (cf. Hirst,
1912, fig. 1).
A very characteristic species. Coxa I with one, coxa III with two
and coxa IV with one broad posterior spine. Length of idiosoma:
0.9 mm. — KENYA, off a porcupine *creightoni* Hirst, 1912
- 2 (1) Second coxa with one posterior spine 3
- 3 (4) Coxa II with one broad posterior spine and two anterior ones, the
inner being directed backwards (cf. Hirst, 1912, fig. 2).
Coxa I without spine, coxae III and IV with one each. Length of
idiosoma: 0.7 mm. — LIBERIA, off a squirrel
liberiensis Hirst, 1912
- 4 (3) Coxa II without a second, backwardly directed anterior spine 5
- 5 (6) Genital plate about as broad as long (cf. De Meillon and Lavoipierre,
1944, fig. 5).
Coxa II with one, coxa III with two and coxa IV with one posterior
tooth-like spine. Length of idiosoma: 0.7 mm. — TRANSVAAL,
off *Rattus rattus* L. . . *latiscutatus* De Meillon & Lavoipierre, 1944
- 6 (5) Genital plate nearly twice as long as broad (cf. Radford, 1942, fig. 12).
Armature of coxae as in the foregoing species. Length of idiosoma:
0.6 mm. — UGANDA, off *Otomys* spec. . . *otomys* Radford, 1942

Da Fonseca (1948) created a further *Hirstionyssus* species with the following words: "The male ascribed by Hirst in 1921 to his species *Bdellonyssus aethiopicus* (Hirst, 1921)* must in all probability be included in this genus as a new species, *Hirstionyssus hirsti*, sp.n."

There are no reasons at all to believe that Hirst did not describe the male of his *Liponyssus aethiopicus*. We, therefore, regard *H. hirsti* Fonseca as a synonym of *L. aethiopicus* Hirst.

Of the genera *Lepronyssoides* Fonseca and *Liponyssella* Hirst, only one species each are known from the Ethiopian or Madagascan Region respectively, namely *Lepr. transvaalensis* Zpt. (1950) and *Lip. madagascariensis* Hirst (1922).

The worldwide distributed genus *Liponyssus* Kolenati contains the following Ethiopian species.

- 1 (2) Anal plate strongly elongate, three times as long as broad (fig. 9).
Length of dorsal shield: 1.2-1.3 mm. — TRANSVAAL, off *Rhinolophus geoffroyi* Smith. *rhinolophi* n. sp.
- 2 (1) Anal plate shorter, length less than twice the width 3
- 3 (4) Sternal plate with the posterior margin thickened (cf. Hirst, 1922, fig. 25).
Length of the idiosoma not distended 0.61 mm. — NYASALAND, ANGLO-EGYPTIAN SUDAN, off *Elephantulus* sp. and off bats.
aethiopicus Hirst, 1922
- 4 (3) Sternal plate not thickened posteriorly 5
- 5 (10) Genital plate parallel or widened in or behind the middle, tip broadly rounded 6
- 6 (7) Genital plate widened near the hind margin (cf. Radford, 1942, fig. 11).
Anal plate about as long as broad, sternal plate with pointed corners. Length of idiosoma: 0.7 mm. — UGANDA, off *Protoxerus stangeri* Waterh. *sangsteri* Radford, 1942**
- 7 (6) Genital plate windened in the middle or more or less parallel 8
- 8 (9) Anal plate about twice as long as broad, sternal plate with rounded anterior corners (cf. Hirst, 1922, fig. 36). Length of dorsal shield not exactly known. — S. ARABIA, SOMALILAND, off *Rhinolophus clivosus* Cretschman *longimanus* Kolenati, 1857
(syn. *ellipticus* Kolenati, 1857)
- 9 (8) Anal plate about as long as broad, sternal plate with more or less rectangular anterior corners (fig. 10).
Length of dorsal shield 0.51-0.55 mm. — CAPE PROVINCE off *Georchus capensis* Pallas. *lawrencei* n. sp.
- 10 (5) Genital plate widened at base, pointed to the tip 11
- 11 (14) Genital plate very slender, more than three times as long as broad at the base 12
- 12 (13) Dorsal shield slender, about three times as long as broad (cf. Hirst, 1914, fig. 12).
Length of idiosoma: 0.8 mm. — COSMOPOLITAN in tropical and subtropical regions. On domestic rats, sometimes also on other murids and on domestic rabbits *bacoti* Hirst, 1913
- 13 (12) Dorsal shield wider, about twice as long as broad (cf. Hirst, 1915, fig. 1).
Length of idiosoma: 0.65-0.7 mm. — COSMOPOLITAN in tropical and subtropical regions *bursa* Berlese, 1888
(= *morsitans* Hirst, 1915)

* The year of issue is 1922.

** It seems more likely that this species belongs to *Haemolaelaps*.

- 14 (11) Genital plate shorter and wider, not more than twice as long as broad at the base 15
- 15 (12) Sternal plate more or less rectangular, more than twice as broad as long; genital plate broader at base 16
- 16 (17) Genital plate long, coxa II with long anterior spur (cf. Radford, 1942, fig. 11).
Length of idiosoma: 0.85 mm. — UGANDA, off *Dendropicos fuscescens laepidus* Cabani and Heine .. *dendropicos* Radford, 1942
- 17 (16) Genital plate shorter, coxa II with short anterior spur (fig. 11).
Length of dorsal shield: 0.56-0.65 mm. — CAPE PROVINCE, off *Nyctinomus bocagei* Seabra. *nyctinomi* n. sp.
- 18 (15) Sternal plate with the sides strongly converging anteriorly, at the hind margin about twice as broad as long in the middle-line (cf. Zumpt, 1950b, fig. 4).
Length of dorsal shield: 0.53 mm. — MADAGASCAR, off *Chaerephon leucostigma* Allen *forsythi* Zumpt, 1950

6. *Dermanyssinae*

- 1 (2) Dorsal shield entire, anal plate not egg-shaped. — WORLDWIDE
Dermanyssus Duges, 1834
- 2 (1) Dorsal shield divided; anal plate egg-shaped. — HOLARCTIC REGION *Allodermanyssus* Ewing, 1923

Only the cosmopolitan *Dermanyssus gallinae* Deg. is known from the Ethiopian Region where it has been introduced from other parts of the world. The genus is originally a holarctic one. *Allodermanyssus sanguineus* Hirst, the vector of N. American Rickettsial Pox, has not yet been recorded from Africa south of the Sahara, but it is likely to be introduced by house-rats and mice.

7. *Railletinae*

Only one genus *Railletia* Trouessart is known which contains the following two species :

- 1 (2) Sternal plate twice as long as broad (cf. Radford, 1938, fig. 7). — UGANDA, off *Kobus defassa* Ruppelt *hopkinsi* Radford, 1938
- 2 (1) Sternal plate only a little longer than broad (cf. Vitzthum, 1943, fig. 483). — Probably WORLDWIDE on cattle but not yet recorded from the Ethiopian Region *auris* Leidy, 1872

8. *Entonyssinae*

- 1 (2) Chelicerae with a long movable arm which is strongly recurved outwards with neither teeth nor setae, fixed arm wanting. — S. AMERICA *Pneumophionyssus* Fonseca, 1940
- 2 (1) Chelicerae with movable arm falciform and fixed arm harpoon-like with a retrograde tooth or with both arms falciform generally without teeth or setae 3
- 3 (4) Tarsus I without pulvillus; chelicerae bifid at apex; dorsal shield broadly truncate, small, extending only to a little behind coxae IV. — AFRICA *Hammertonia* Turk, 1947
- 4 (3) Tarsus I with pulvillus; chelicerae not bifid, dorsal shield rather broadly rounded or pointed and covering greater part of dorsum. — HOLARCTIC REGION *Entonyssus* Ewing, 1923
(syn: *Ophiopneumicola* Hubbard, 1938)
Hammertonia bedfordi Radford (1937) is the only *Entonyssinae* recorded from Africa, south of the Sahara.

9. Halarachninae

- 1 (4) Palpi filiform, as long or longer than the first coxa. Living in the respiratory system of seals 2
- 2 (3) Male and female with two pairs of setae dorsally between posterior margin of dorsal plate and anal plate; and also ventrally between level of coxae IV and anal plate.—COAST OF THE ATLANTIC and PACIFIC OCEANS *Orthohalarachne* Newell, 1947
- 3 (2) Male and female with more than four pairs of setae dorsally between posterior margin of dorsal plate and anal plate; also ventrally between level of coxae IV and anal plate.—COAST OF THE ATLANTIC and PACIFIC OCEANS *Halarachne* Allman, 1847
- 4 (1) Palpi reduced to papilla-like cones not as long as first coxa. Living in the respiratory system of land-mamals. — WORLDWIDE
Pneumonyssus Banks, 1901

Orthohalarachne and *Halarachne* contain exclusively parasites of seals, a study of these genera was recently done by Newell (1947). The genus *Pneumonyssus* urgently needs a revision, the present state being very unsatisfactory. *P. caninum* Chandl and Ruhe (1940) was described from a North American dog, *P. procavians* Radford (1938) from *Procapra capensis* Pallas, *P. congoensis* Ewing (1929) and *P. duttoni* Newstead & Todd (1906) from African monkeys.

10. Rhinonyssinae

- 1 (4) Stigma without peritreme 2
- 2 (3) Dorsum with one podosomal plate only. — EUROPE
Sternostomum Trouessart, 1895
- 3 (2) Dorsum with one podosomal and one opisthosomal plate.—EUROPE, AFRICA *Sternostoma* Berlese & Trouessart, 1889
- 4 (1) Stigma with a short, dorsal peritreme 5
- 5 (10) Dorsum with one plate only 6
- 6 (9) Chelicerae of normal shape; digiti small, but nevertheless shear-like 7
- 7 (8) Peritreme in the middle of the body, level with the 3rd or 4th coxae. — WORLDWIDE *Rhinonyssus* Trouessart, 1894
- 8 (7) Peritreme in the posterior end of the body, far behind the 4th coxae. — N. AMERICA *Rallinyssus* Strandtmann, 1948
- 9 (6) Chelicerae with a big basal piece, otherwise very slender, needle-like; digitus mobilis reduced to a very small claw on the tip of the last segment. — AUSTRALIA *Rhinonyssoides* Hirst, 1921
- 10 (5) Dorsum with several dorsal plates 11
- 11 (12) Dorsum with more than 10 small plates of indistinct shape. — AMERICA, S. AFRICA *Larinyssus* Strandtmann, 1948
- 12 (11) Dorsum with up to five plates, at least one of these large and well defined 13
- 13 (14) Dorsum with one large podosomal plate and four small ones laterally. — EUROPE *Rhinoecius* Cooreman, 1946
- 14 (13) Dorsum with no more than three plates, which are all well defined 15
- 15 (16) Dorsum with three plates, namely a podosomal, an opisthosomal and a small pygidial plate. — EUROPE *Ptilonyssoides* Vitzthum, 1935
- 16 (15) Dorsum with two plates 17
- 17 (18) Dorsum with a podosomal and an opisthosomal plate, pygidial one wanting. — MADAGASCAR *Neonyssus* Hirst, 1921
(syn: *Neonyssoides* Hirst, 1923)
- 18 (17) Dorsum with a podosomal and a small pygidial plate, opisthosomal one wanting. — EUROPE *Ptilonyssus* Berlese & Trouessart, 1889

Four of the genera keyed out above have been found in the Ethiopian and Madagascan Regions, namely, *Sternostoma*, *Rhinonyssus*, *Larinyssus* and *Neonyssus*.

Sternostoma contains one Ethiopian species, *S. tracheacolum* Lawrence (1948) found in the trachea of canaries.

Larinyssus is monotypic and based on *L. orbicularis* Strandtmann (1948) collected in the U.S.A. In the collections of the South African Institute for Medical Research, we found a tube with nasal mites from *Larus dominicanus* shot on Dyer Island, Cape Province, and kindly forwarded by Mr. R. W. Rand. Dr. Strandtmann studied these specimens and confirmed their identity with his N. American species.

Neonyssus intermedius Hirst (1922) is a Madagascan species, a second species of this genus was described from Europe.

With respect to the genus *Rhinonyssus* only *Rh. africanus* n. sp. has been found in the Ethiopian Region. There are, however, three further species described from hosts which are migrants to S. Africa, so that the mites are likely to be collected one day in Africa too. We have, therefore, included them in the following key:

- 1 (2) Idiosoma not exceeding 1 mm. in length.
A stout species which has some similarities with *echinipes*, but it is still broader than this species and the hairs are so strongly reduced that only a few are recognizable (fig. 12). Length of idiosoma: 0.80-0.98 mm.—N A T A L, on *Asio capensis* Smith .. *africanus* n. sp. 3
- 2 (1) Idiosoma exceeding 1 mm. in length
- 3 (4) Body very slender, prosoma not broader than the opisthosoma, the latter about as long as the prosoma (cf. Vitzthum, 1935, fig. 3/4).
Recorded from *Laprimulgus europaeus* L. which is a migrant to S. Africa. A re-description of this old species is given by Vitzthum (1935). Length of idiosoma: 1.6 mm. *nitzschi* Giebel, 1871
- 4 (3) Body less slender, prosoma always broader than the opisthosoma which is distinctly shorter than the prosoma 5
- 5 (6) More slender than *echinipes*. Last pair of legs distinctly enlarged, tibiae broader than long (cf. Hirst, 1921, fig. 6). Length of idiosoma: 1.4-1.5 mm.
Collected from *Arenaria interpres* L. an arctic-breeding bird but scattered along all coasts of the world and commonly found in S. Africa *coniventris* Trouessart, 1894
- 6 (5) Stouter. Last pair of legs slender, tibiae a little longer than broad (cf. Hirst, 1921, fig. 3).
Length of idiosoma: 1.4-1.5 mm. Described from *Charadrius hiaticula* L., a migrant from Europe *echinipes* Hirst, 1921

IV. DESCRIPTION OF THE NEW GENERA AND SPECIES

1. *Sternolaelaps* nov. gen.

This genus is proposed for *Euhaemagamasus utatensis* Ewing (1933) and transferred to the *Laelaptidac*. The generic features may be taken from the key on page 68.

2. *Davisiella* nov. gen. *reticulata* nov. sp.

This species (fig. 1) is closely related to the species of the subgenus *Haemolaelaps* but some outstanding features justify a generic separation.

Striking are the greatly enlarged mouth-parts and the strongly reticulated plates and legs. There are two kinds of reticulation. Dorsal plate and the segments of the legs, with the exception of the coxae, have a leathery appearance, whereas the coxae and ventral plates show a pattern of very distinct horizontal and vertical lines similar to the reticulation found in many *Haemolaelaps* species. For the sake of clearness the first kind of pattern has been omitted in the drawing. A third outstanding feature is a small tooth-like spine on the inner edge of the first coxa. The other features of taxonomic importance are the same as in *Haemolaelaps*. Chelae (female sex only known) shearlike, with a few large teeth on each arm and with a seta on the digitus fixus. Dorsal plate undivided and covering nearly the whole idiosoma; sternal plate of normal shape and with three pairs of bristles, genital plate tongue-shaped, with one pair of genital hairs only; anal plate triangular with three hairs.

Genotype: *Davisiella reticulata* n. sp.

The genus is named in honour of Mr. D. H. S. Davis, Ecologist of the Plague Research Laboratory, Union Health Department.

Female: Dorsal plate with distinct shoulders, gradually narrowing to the posterior tip; the length is 0.941 mm., the greatest width 0.547 mm. The whole idiosoma measures 0.992 mm. Narrowest width of sternal plate 0.171 mm., length in the mid-line 0.18 mm.

Dorsum (fig. 1b) not completely covered by the pointed dorsal plate but with relatively short and sparse hairs.

Venter (fig. 1a) with a sternal plate about as long as it is wide in the narrowest parts. Presternal area as strongly reticulated as the sternal plate. Endopodal plates distinct, seta arises on the inside of its concavity. Genital plate of peculiar shape, tongue-like with a distinct angle at its widest part. Metapodal plates developed, but only the posterior pair distinct, the other two are very small and difficult to see. Anal plate triangular, with three short setae. Uncovered area of the venter beset with only a few short hairs as shown in the drawing. Peritreme narrow stretching from the first to the fourth coxa, stigma oval, opening between the third and fourth coxa.

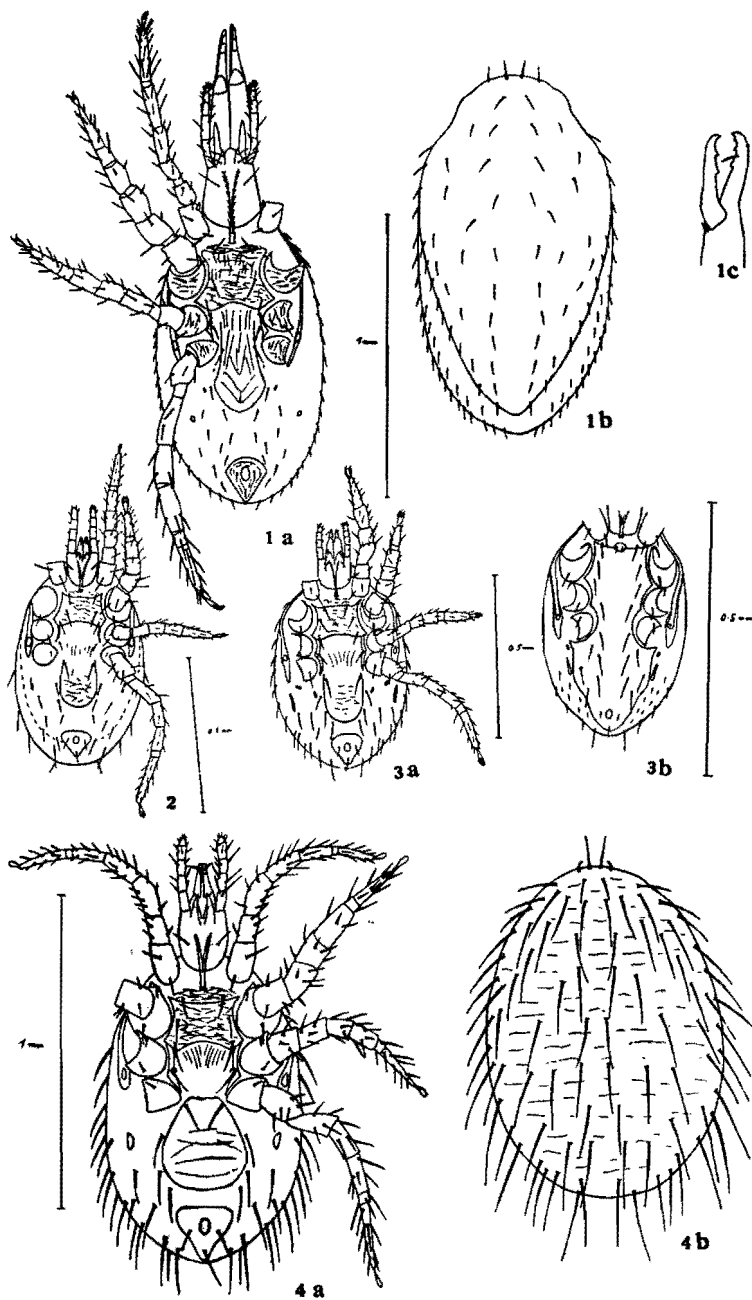
Legs slender but having a striking, rough, leather-like reticulation. First coxa with a short, but sharply pointed and relatively broad tooth-like spine, on the inner margin. Hairs on all segments of legs strong, tarsi with pulvilli and claws. Chelae (fig. 1b) large, with two teeth on the movable arm and three teeth and one seta on the digitus fixus.

Male and immature stages unknown.

The description is based on 2 females from Vumba, Umtali, S. RHODESIA, 1 Jan., 1949. *Host:* *Crocidura luna* Dollman. Types in the collection of the South African Institute for Medical Research.

3. *Hypoaspis (Haemolaelaps) eos* nov. sp.

This species (fig. 2) was collected from the body of a *Rhodomys pumilio* so that we first thought that we were dealing with *H. rhabdomys* Radford (1939). However, a comparison with the drawing given by the author showed that there were a few important differences. Our specimens, for instance, showed only two pairs of hairs beside the genital plate instead of



three, the outer metapodal plates are line-shaped and the genital plate is broader and a little widened posteriorly. Through the kindness of Dr. R. du Toit, Onderstepoort, we received two specimens of the true *rhabdomys* identified by Radford, which confirmed the correctness of the drawing, so that our specimens are to be regarded as a new species. The type specimens of *rhabdomys* Radford appear to have been lost, the specimens we received from Onderstepoort were collected at a later date and not taken off *Rhabdomys* but off an *Otomys* spec.

Female — The measurements of the dorsal shield vary from 0.530-0.616 mm. in length and from 0.376-0.428 mm. in width, if engorged the total length of the idiosoma can reach 0.685 mm. The narrowest width of the sternal plate varies from 0.1-0.137, the length in the middle line from 0.07-0.1 mm.

Dorsum sparsely beset with slender hairs, dorsal shield reticulated, with weakly developed shoulders, anterior margin with two pairs of bristles. In engorged females, the dorsal shield does not completely cover the idiosoma.

Venter with the sternal plate broader than long, hairs and pores as usual; presternal area reticulated. Genital plate tongue-shaped, reticulated, provided with one pair of bristles at the base and bordered by two further pairs. Only the outer pair of metapodal plates distinct and line-shaped. Anal plate triangular. The posterior uncovered area of the venter normally with six pairs of hairs, one of these is placed between the genital and anal plates. Stigma opens between the third and fourth coxae.

Legs slender, without any outstanding features. Chelae shear-like, bluntly denticulated, a seta is not clearly visible on the digitus fixus.

Male and nymphal stages not known.

The description is based on 21 females from Rietfontein, near Johannesburg, TRANSVAAL, 9 August, 1950, collected from *Rhabdomys pumilio* (Sparm.). Types in the collection of the South African Institute for Medical Research, Johannesburg. We have received a further single female from Pietermaritzburg, NATAL, taken off the same host.

4. *Hypoaspis (Haemolaelaps) oliffi* nov. sp.

A striking feature of this new species (fig. 3) is the long line-shaped outer metapodal plates, which are differently shaped in similar-looking species, such as *bathyerqus*. *H. eos* with metapodal plates as in *oliffi* has the two inner ones wanting or at least quite indistinct, apart from differences in the pattern of the opisthosomal hairs. *H. tateronis*, also apart from the opisthosomal hair-pattern, has the genital plate narrower than *oliffi*.

Fig. 1. *Davisiella* n. gen. *reticulata* n. sp.

(a) Ventral view of female. (b) Dorsal view of female.
(c) Chelicera of female.

Fig. 2. *Hypoaspis (Haemolaelaps) eos* n. sp., ventral view of female.

Fig. 3. *Hypoaspis (Haemolaelaps) oliffi* n. sp.

(a) Ventral view of female. (b) Ventral view of male.

Fig. 4. *Hypoaspis (Haemolaelaps) rhodesiensis* n. sp.

(a) Ventral view of female. (b) Dorsal plate of female.

Female. — The measurements of the dorsal shield vary from 0.6-0.65 mm. in length and from 0.36-0.427 mm. in width. There are no engorged specimens for description. The narrowest width of the sternal plate is about 0.137, the length in the middle-line varies from 0.09-0.1 mm.

Dorsum sparsely beset with slender hairs, dorsal shield reticulated, with weakly developed shoulders, anterior margin with two pairs of bristles.

Venter with the sternal plate broader than long, hairs and pores as usual, presternal area reticulated. Genital plate tongue-shaped, not or only a little expanded behind the genital hairs, reticulated, provided with one pair of bristles at the base and bordered by three further pairs. Outer metapodal plates long and narrow, line-shaped, the inner ones quite distinct and also more or less elongate. Anal plate triangular. Opisthosomal area with more hairs, compared with *eos*. Peritreme long, stigma opens between coxae III and IV.

Legs slender, without outstanding features. Chelae shear-like, seta of the digitus fixus weak, but distinct.

Male. — Two males have the dorsal shield 0.426 and 0.445 mm. long and 0.256 mm. wide. Ventral shield with ten pairs of hairs, apart from the three usual setae near the anal opening. Two metapodal plates on each side of the ventral shield, one of these elongate as in the female. Chelae with long and narrow digiti modified as spermatophore carriers.

Nymphal stages unknown.

The description is based on twelve females (incl. holotype) from Vrededorst, ORANGE FREE STATE, 16 August, 1949, and nine females and two males from Zuurbekom, Roodepoort district, TRANSVAAL, 9 May, 1949. Both series were collected in nests of *Tatera brantsii* (A. Smith). Types in the collection of the South African Institute for Medical Research, Johannesburg.

The species is named in honour of the collector, Mr. W. D. Oliff, Plague Laboratory, Johannesburg.

5. *Hypoaspis* (*Haemolaelaps*) *rhodesiensis* nov. sp.

This species (fig. 4) is characterised by the peculiar shape of the genital plate which is similar to that of *H. (Androlaelaps) africanus* Zpt. and by long and thin, sparse hairs on the dorsum and venter.

Female. — The measurements of the dorsal plate vary from 0.804-0.923 mm. in length and from 0.599-0.701 mm. in width. If engorged, total length and width of the body (without capitulum) may reach 1.03 mm. and 0.735 mm. respectively. The narrowest width of the sternal plate varies from 0.103-0.12 mm., the length in the mid-line is 0.171-0.188 mm.

The dorsal plate (fig. 4b) covers the whole body in unfed specimens; in engorged ones the soft part of the idiosoma distends, mainly in the hind part. Hairs long and slender, arrangement as in the figure. Surface of the plate with a fine but distinct reticulation.

Venter (fig. 4a) with a sternal plate broader than long, bristles and pores as usual. Presternal area reticulated as in the sternal plate. Genital plate extending far posteriorly, its shape is very peculiar being much widened

in the hind part; side margins in the anterior part a little variable, in some specimens they are straight, in others more or less concave. Only one pair of metapodal plates present lying between the middle of the genital plate and the body margin. They are relatively large and crescent-shaped. Uncovered area of the venter beset with only a few pairs of long hairs, beside the genital plate there are three pairs, no hairs between the latter and the anal plate. Stigma opens between the third and fourth coxa, peritreme reaching first coxa.

Legs slender, without outstanding features. Epistome triangular, relatively large. Chelae shear-like, digitus fixus with a seta which is, however, often difficult to see.

Male and immature stages unknown.

The description is based on 23 females (incl. holotype) from Dowa, Rusapi, S. RHODESIA, 1 November, 1948. Type host: *Saccostomus campestris* Peters. Types in the collection of the South African Institute for Medical Research. We received a further single female off the same host from Kumalo, Bulawayo, 29 April, 1949.

6. *Hypoaspis (Haemolaelaps) villosissimus* Berlese, 1918

We have received 23♀ specimens of this mite from Kumalo, Bulawayo, S. Rhodesia, taken off *Saccostomus campestris* Peters, which is characterized by a very densely haired body. The species described by Berlese (1918) was taken from the same host. In his diagnosis there is nothing contrary to the important features as seen in our specimens and we therefore refer them to this species.

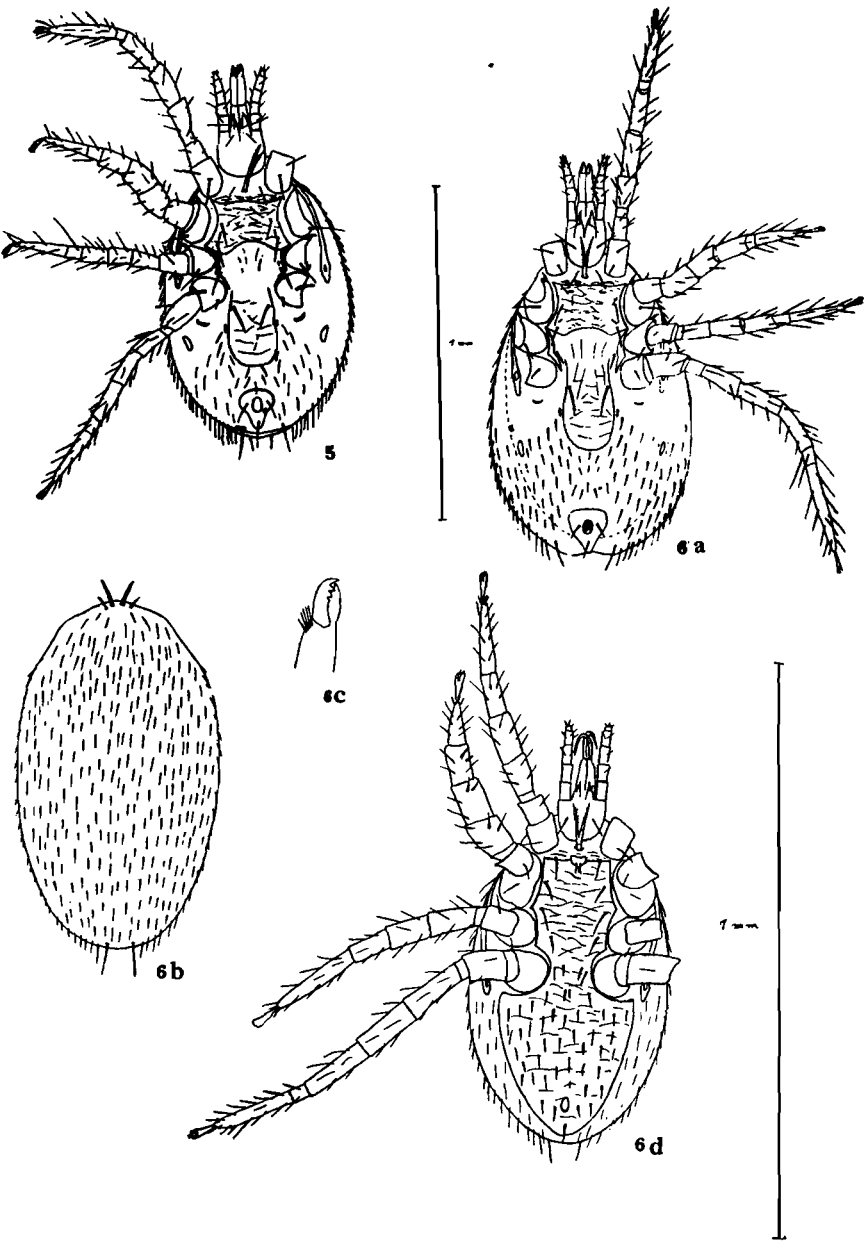
H. villosissimus (fig. 5) is very closely related to *taterae* sp. nov. described next and at first we confused it with this species. But the female is somewhat smaller and there are less hairs on the posterior part of the venter than in *taterae*.

The measurements of the dorsal shield vary from 0.701-0.752 mm. in length and from 0.428-0.479 mm. in width. If engorged the total width and length (without capitulum) of the body may reach 0.530 mm. and 0.770 mm. respectively. The sternal plate is 0.103 mm. long and 0.154 mm. broad at its narrowest point. A striking feature as compared with *taterae* is the smaller number of hairs on the posterior part of the venter. Between the genital and anal plates there are only two rows of hairs instead of three. The dorsal plate is as densely haired as in *taterae* and the setae of the digitus fixus are also absent.

7. *Hypoaspis (Haemolaelaps) taterae* nov. sp.

This species is similar to *H. villosissimus* Berlese and, like it, characterized by a densely haired dorsum. The genital plate too has the same shape but there are about three rows of hairs instead of two between it and the anal plate. Furthermore, *H. taterae* is a little larger than *H. villosissimus*.

Female (fig. 6). — The measurements of the dorsal shield vary from 0.838-0.889 mm. in length and from 0.445-0.547 mm. in width. If partly or fully engorged the total width and length (without capitulum) of the body may reach 0.650 mm. and 0.941 mm. respectively. The narrowest width of



the sternal plate in all specimens is about 0.17 mm., the length in the mid-line varies from 0.120-0.154 mm., the frontal border, however, is not always quite distinct being more or less transient to the reticulated presternal area.

Dorsum (fig. 6b) densely beset with thin and relatively short hairs, anterior margin of the dorsal plate with two pairs of bristles, posterior margin with one pair of longer conspicuous hairs. In engorged specimens the dorsal plate does not completely cover the body.

Venter (fig. 6a) with a sternal plate broader than long, bristles and pores as usual. The presternal area reticulated and more or less transient to the sternal plate, the anterior margin of which is not always well defined. Genital plate tongue-shaped, reticulated and provided with one pair of bristles. Three pairs of metapodal plates, two of these are small, the posterior quite distinct, elongated oval. Anal plate pear-shaped, with the usual three setae. Uncovered area of the venter more densely beset with hairs than *H. villosissimus*, there are three rows of hairs between the genital and anal plate. Stigma opens near the fourth coxa, peritreme reaching first coxa.

Legs slender, without any outstanding features. Epistome triangular, relatively large, beset with minute hairs. Chelae (fig. 6c) shear-like, digitus mobilis with two strong teeth beyond the sharply pointed tip. On the digitus fixus there is no seta to be seen in any of the specimens.

Male (fig. 6d). — The two males measure 0.599 x 0.359 mm.

Dorsal plate beset with dense hairs as in the female. One complete ventral shield which nearly covers the whole venter, posterior part provided with a great number of hairs as shown in the figure. Chelae modified in to long and narrow spermatophore carriers.

Immature stages not known.

The description is based on 41 females (incl. holotype) and 2 males from Zuurbekom, Roodepoort district, TRANSVAAL, 9/10 May, 1949. Type-host: *Tatera brantsii* (A. Smith). Further specimens have been seen from van Wyk's Rust near Johannesburg, off *Tatera brantsii*; St. Marks district, TRANSKEI, off *Tatera brantsii*; and Wankie district, S. RHODESIA, off *Tatera schinzi* (Noack). Types in the collection of the South African Institute for Medical Research.

8. *Hypoaspis* (*Haemolaelaps*) *labuschagnei* nov. sp.

A species characterized by the spoon-shaped genital plate, large size and a sparsely haired dorsal shield.

Female (fig. 7). — The measurements of the dorsal shield vary from 0.892-1.026 mm. in length and from 0.530-0.616 mm. in width. Sternal plate with ill-defined anterior border according to the strongly reticulated

Fig. 5. *Hypoaspis* (*Haemolaelaps*) *villosissimus* Berlese, ventral view of female.

Fig. 6. *Hypoaspis* (*Haemolaelaps*) *tatae* n. sp.

(a) Ventral view of female. (b) Dorsal plate of female.
(c) Chelicera of female. (d) Ventral view of male.

presternal area, the length in the mid-line is therefore not exactly measurable but is about 0.14 mm. whereas the narrowest width varies from 0.14-0.17 mm.

Dorsum sparsely covered with slender and slightly curved hairs, dorsal shield reticulated, in the posterior basal half with two pairs of lateral rounded platelets, shoulders weakly developed.

Ventr with the sternal plate a little broader than long, presternal area strongly reticulated and more or less transient to the sternal plate, hairs and pores as usual. Endopodal plates distinct. Genital plates expanded posteriorly, reticulated, bordered by two pairs of hairs, a third pair between it and the genital plate. In some specimens this third pair of hairs more or less approach the margin of the genital plate; so that it appears as if the genital plate were bordered by three pairs of hairs and the interstitial one wanting. Anal plate triangular, as long as broad. Outer metapodal plate more or less oval, quite distinct, whereas the inner ones are not detectable.

Legs slender, without any outstanding features. Chelae shear-like, digitus mobilis with a seta which may, however, be indistinct in some preparations.

Male and nymphal stages unknown.

The description is based on seven females from Amersfort, E. TRANSVAAL, 3 August, 1948, collected in a nest of *Rattus rattus* (L.). We received, furthermore, 1♀ from Gingindhlovo, ZULULAND, 7 July, 1950, off a specimen of *Otomys tropicalis* Thomas, 1♀ from Pietermaritzburg, NATAL, off *Otomys irroratus* Brants, and 2♀ from Sheldon, CAPE PROVINCE, 25 August, 1950, off *Mastomys coucha* (Smith).

The species is named in honour of Mr. P. N. Labuschagne who collected the type series. All mentioned specimens in the collection of the South African Institute for Medical Research, Johannesburg.

9. *Steatonyssus natalensis* nov. sp.

The key to *Liponyssus* s. lat. given by Hirst (1922) takes this species to *javensis* Oudemans which is unknown to us. Oudemans' description is very poor and without any drawings, so that we are not able to give separating features to our species. But it is highly improbable that an Indo-Malayan *Steatonyssus* species will also occur on a South African bat.

Female (fig. 8). — Dorsal shield divided and similar in shape to that of *biscutatus* Hirst, reticulation weak, podosomal plate 0.274 mm. long, with about 12 pairs of hairs, opisthosomal plate 0.360 mm. long with 3 pairs of hairs. Our single specimen which is probably only partly engorged has a total length of 0.752 mm. (without capitulum).

Sternal plate very weakly sclerotized and hardly visible, more or less crescent-shaped, with three pairs of setae; genital plate elongate and pointed, with one pair of short genital hairs. Anal plate about twice as long as broad, tip truncated, with the usual three setae. Peritreme tube-shaped, anteriorly reaching the second coxa. Legs slender, with well developed claws and pulvilli. The measurements of the legs are as follows (in μ , without claws).

Number of leg	tarsus	tibia	genu	femur	trochanter
I	148	92	92	92	32
II	84	60	80	72	60
III	100	64	64	64	60
IV	140	92	80	100	80

Male. — The specimen, which is not in a very good condition, has a total length (without capitulum) of 0.428 mm. The dorsal and holoventral shields are undivided. The exact number of hairs of the ventral shield is not clearly recognizable.

One pair of this species was collected by Dr. R. F. Lawrence, Natal Museum, from a specimen of *Miniopterus natalensis* near Pietermaritzburg, NATAL. Holotype (♀) and paratype (♂) in the collection of the Natal Museum, Pietermaritzburg.

10. *Liponyssus rhinolophi* nov. sp.

A very characteristic species having a club-shaped anal plate which is three times as long as broad; the shape of the sternal plate and the dorsal shield are also striking (fig. 9).

Female. — Dorsal shield reticulated, elongate in shape, narrowed at the level of the fourth coxae; the length varies from 1.2-1.3 mm., width about 0.4 mm. Engorged females reach a body-length up to 2.5 mm.

Sternal plate triangular, hind margin emarginated, first pair of setae on the reticulated presternal area, the posterior two pairs of setae on the edge of the plate. Genital plate widest at base, slightly narrowed and rounded at the tip, with one pair of setae. Anal plate club-shaped, elongate, paired setae far behind the anal opening. Peritreme tube-shaped reaching from the first pair of legs to the fourth. Legs slender, with well-developed claws and pulvilli. The measurements of the legs of the female holotype are as follows (in μ , without claws).

Number of leg	tarsus	tibia	genu	femur	trochanter
I	462	274	239	325	103
II	393	222	205	291	103
III	410	205	205	291	120
IV	513	274	274	376	171

Male. — Not known.

Protonymph. — Anterior dorsal shield broadest at the posterior margin,

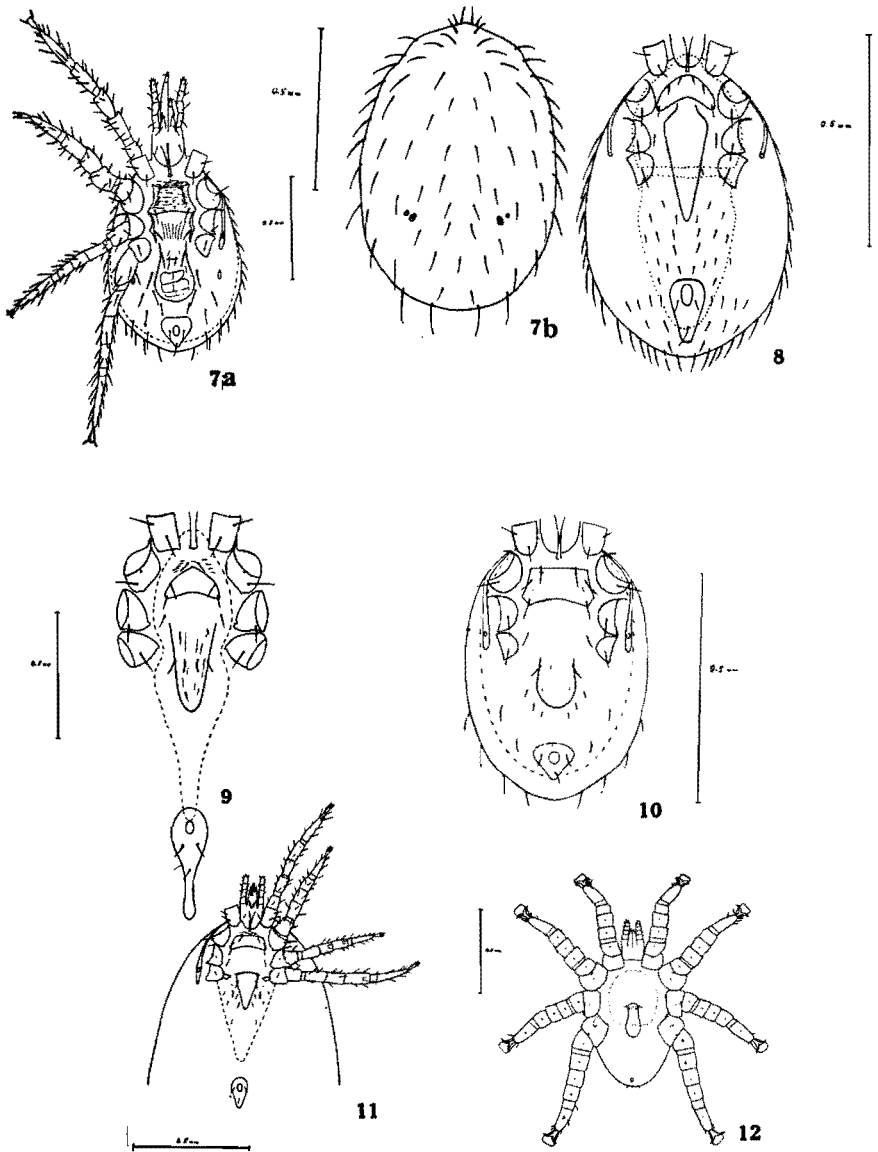


Fig. 7. *Hypoaspis (Haemolaelaps) labuschagnei* n. sp.
 (a) Ventral view of female. (b) Dorsal plate of female.
 Fig. 8. *Steatonyssus natalensis* n. sp., ventral view of female.
 Fig. 9. *Liponyssus rhinolophi* n. sp., ventral view of female.
 Fig. 10. *Liponyssus lawrencei* n. sp., ventral view of female.
 Fig. 11. *Liponyssus nyctinomi* n. sp., ventral view of female.
 Fig. 12. *Rhinonyssus africanus* n. sp., ventral view of female.

truncate. Anal plate normally pear-shaped, not elongate as in the female. Length of body (without capitulum): 462μ .

This species was fairly common on *Rhinolophus geoffroyi* Smith in the Sterkfontein Caves, TRANSVAAL, June and July, 1948 and 1949. The description is based on five females and 1 nymph, further material was accidentally lost. Type material in the collection of the South African Institute for Medical Research.

11. *Liponyssus lawrencei* nov. sp.

Similar to *L. longimanus* Kolen, but easily separable from it by the shape of the ventral plates.

Female (fig. 10). — Dorsal shield egg-shaped, weakly sclerotized and sparsely haired, the length varies from 0.513-0.547 mm. The idiosoma of engorged specimens may reach a total length of 0.6 mm.

Sternal plate about twice as broad as long, anterior corners more or less rectangular, three pairs of setae and two pairs of pores. Genital plate tongue-shaped, with one pair of setae at the base and two pairs of slit-like pores. Hairs of the soft part of the opisthosoma scanty, three pairs border the genital plate and two pairs are placed laterally. Anal plate triangular, as long as broad. Peritreme reaching from the first coxa to the fourth. Legs slender, with well developed claws and pulvilli. The measurements of the legs of the holotype are as follows (in μ , without claws).

Number of leg	tarsus	tibia	genu	femur	trochanter
I	100	68	72	68	48
II	88	60	60	60	60
III	88	48	48	60	60
IV	152	68	72	92	60

Male and nymphal stages. — Not known.

Based on nineteen females, collected from *Georchus capensis* (Pallas) near Wynberg, CAPE PROVINCE. The species is named in honour of the well-known S. African Acarologist, Dr. R. F. Lawrence, Director of the Natal Museum, who sent this specimen to us. Holotype and nine paratypes in the collection of the Natal Museum, nine further paratypes in the collection of the South African Institute for Medical Research, Johannesburg.

12. *Liponyssus nyctinomi* nov. sp.

This species is closely related to *L. forsythi* Zumpt (1950) described from a bat. The main separating features concern the shape of the sternal and genital plates of the female (fig. 11) as laid down in the key.

Female. — Dorsal shield club-shaped, reticulated, 0.56-0.65 mm. long and at the widest point between coxae III about 0.26 mm. broad. The fully engorged female is about 1 mm. long.

Sternal plate rectangular, about $2\frac{1}{2}$ times as broad as long, with three

pairs of setae. Genital plate with strongly converging sides and shortly-rounded at the tip, with one pair of basal setae. Anal plate pear-shaped, twice as long as broad, paired hairs level with the middle of the anal opening. Peritreme narrow, its tip reaching or surpassing the hind coxa. Legs slender, with well-developed claws and pulvilli. The measurements of the legs of the female holotype are as follows (in μ , without claws).

Number of leg	tarsus	tibia	genu	femur	trochanter
I	176	88	88	25	56
II	120	60	80	88	60
III	120	60	68	96	60
IV	160	88	88	120	80

Male. — Not known.

Protonymph. — Very similar to that of *L. forsythi* Zpt. and *L. robustipes* Ewing, a drawing of the lastnamed is given by da Fonseca (1948). *L. nyctinomi* as well as *L. forsythi* are distinguished from *L. robustipes* by having the greatest width of the anterior dorsal plate in the middle and towards the posterior end. Length of body (without capitulum): 360-400 μ .

The description is based on five females and twenty-one protonymphs from Sheldon, CAPE PROVINCE. They were collected off *Nyctinomus bocagei* Seabra, 28th August, 1950. Types in the collection of the South African Institute for Medical Research, Johannesburg.

13. *Rhinonyssus africanus* nov. sp.

A species characterized by its small and stout body and the unusual strong reduction of the body-hairs (fig. 12).

Female. — Dorsal plate very weakly sclerotized, with a few scattered short hairs, of which a pair on the hind border is most distinct. The length of the dorsal plate is 0.34 mm., the total length of idiosoma (without capitulum) varies from 0.8-0.98 mm., the holotype being 0.86 mm. long.

On the venter only a narrow genital plate is recognizable. Legs stout, the measurements of the holotype are as follows (in μ , without claws).

Number of leg	tarsus	tibia	genu	femur	trochanter
I	120	64	80	84	88
II	128	60	68	88	88
III	160	64	84	80	80
IV	180	80	88	104	100

Male and nymphal stages not known.

The description is based on eight females, collected by Dr. R. F. Lawrence in November, 1950, near Pietermaritzburg, NATAL, on a specimen of *Asio capensis* Smith, the marsh-owl. The mites were sitting on the bill near the nasal openings, the nasal cavity itself was unfortunately not opened. Holotype and three paratypes in the collection of the Natal Museum, four paratypes in the collection of the South African Institute for Medical Research, Johannesburg.

SUMMARY

A preliminary study of the Ethiopian species of Laelaptidae (Acarina, Mesostigmata) is given, based on records up to the end of 1950 and on new material collected by the South African Institute for Medical Research, Johannesburg, and the Plague Research Laboratories, Johannesburg. Two new genera and eleven new species have been described and keys drawn up for the parasitic genera of the Laelaptidae of the world, with special emphasis on the Ethiopian species.

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REFERENCES

References not listed herein may be taken from Radford, C. D. (1950): The mites parasitic on mammals, birds and reptiles. *Parasitology*, 40, 366-94.

- Berlese, A. (1910). Acari nuovi. *Redia*, 6, 199-234.
Berlese, A. (1918). Centuria quarta di Acari nuovi. *Redia*, 13, 115-90.
Camin, J. H. (1949). An attempt to clarify the status of the species in the genus *Ophionyssus* Megnin (Acarina: Macronyssidae). *J. Parasit.*, 35, 583-89.
Chandler, W. L., and Ruhe, L. S. (1940). *Pneumonyssus carinum* n. sp., a mite from the frontal sinus of the dog. *J. Parasit.*, 26, 59-70.
Cooreman, J. (1946). *Rhinoecius otti*, n. gen., n. sp. (Acarien, Rhinonyssinae). *Bull. Mus. Hist. Nat. Belg.*, 22, 9, 1-4.
De Meillon, B., and Lavoipierre, M. (1944). New records and species of biting insects from the Ethiopian Region. *J. Ent. Soc. S. Afr.*, 7, 38-67.
Ewing, H. E. (1923). The Dermanyssid mites of North America. *Proc. U.S. Nat. Mus.*, 62, No. 2459, 1-26.
Ewing, H. E. (1929 a). A manual of external parasites. London: Bailliere, Tindall & Cox.
Ewing, H. E. (1929 b). Notes on the lung mites of primates (Acarina: Dermanyssidae) including the description of a new species. *Proc. Ent. Soc. Wash.*, 31, 126-30.
Ewing, H. E. (1933). New genera and species of parasitic mites of the superfamily Parasitoidea. *Proc. U.S. Nat. Mus.*, 82, pt. 30, 1-14.
Fonseca, F. da (1937). New genera and species of Acari "Laelaptidae" from Brazilian rodents. XII Congr. Int. Zool., Lisbon, pp. 1597-1615.
Fonseca, F. da (1940). Notas de Acareologia. *Rev. Ent. S. Paulo*, 11, 104-19.
Fonseca, F. da (1948). A monograph of the genera and species of Macronyssidae

- Oudemans, 1936 (synon: Liponissidae Vitzthum, 1931) (Acari). *Proc. Zool. Soc., Lond.*, 118, 249-334.
- Fox, J. (1946). A new genus, *Borinquolaelaps*, and a new species of mites from rats in Puerto Rico. *J. Parasit.*, 32, 445-52.
- Hirst, S. (1912). On two new parasitic acari of the genus *Leiognathus*, Cn. (Gamasidae). *Bull. Ent. Res.*, 3, 369-72.
- Hirst, S. (1913). On three new species of Gamasid mites found on rats. *Bull. Ent. Res.*, 4, 119-24.
- Hirst, S. (1914). On the parasitic acari found on the species of rodents frequenting human habitations in Egypt. *Bull. Ent. Res.*, 5, 215-29.
- Hirst, S. (1915). On a widely distributed Gamasid mite (*Leiognathus morsitans* sp.n.) parasitic on the domestic fowl. *Bull. Ent. Res.*, 6, 55-58.
- Hirst, S. (1916). Notes on parasitic Acari. Descriptions of two new African mites of the family Gamasidae. *J. Zool. Res.*, 1, 76-81.
- Hirst, S. (1921). On some new or little known Acari, mostly parasitic in habit. *Proc. Zool. Soc., Lond.*, pp. 357-78.
- Hirst, S. (1922). On some new parasitic mites. *Proc. Zool. Soc. Lond.*, pp. 769-802.
- Hirst, S. (1925). Descriptions of new Acari, mainly parasitic on rodents. *Proc. Zool. Soc. Lond.*, pp. 49-69.
- Lawrence, R. F. (1939). A new mite from the South African Pangolin. *Parasitology*, 31, 451-7.
- Lawrence, R. F. (1948). Studies on some parasitic mites from Canada and South Africa. *J. Parasit.*, 34, 364-79.
- Newell, J. M. (1947). Studies on the morphology and systematics of the family Halarachnidae Oudemans, 1906 (Acarina: Parasitoidea). *Bull. Bingham Oceanogr. Coll.*, 10, 235-66.
- Newstead, R., and Todd, J. D. (1906). On a new *Dermanyssid* Acarid. *Mem. Lpool. Sch. Trop. Med.*, 18, 41-4.
- Radford, C. D. (1937). A new species of mite of the genus *Entonyssus* Ewing. *Northw. Nat.*, 12, 38-42.
- Radford, C. D. (1938). *Pneumonyssus procavians* n.sp., a new lung mite. *Ann. Transv. Mus.*, 19, 147-52.
- Radford, C. D. (1939). Notes on some new species of parasitic mites. *Parasitology*, 31, 243-54.
- Radford, C. D. (1940). Notes on some new species of parasitic mites. Pt. 3. *Parasitology*, 32, 91-104.
- Radford, C. D. (1941). Notes on some new species of parasitic mites. Pt. 4. *Parasitology*, 33, 306-15.
- Radford, C. D. (1942 a). New parasitic mites (Acarina). *Parasitology*, 34, 295-307.
- Radford, C. D. (1942 b). New ectoparasitic mites (Acarina) from Uganda. *Parasitology*, 34, 185-194.
- Radford, C. D. (1944). New parasitic mites (Acarina) from rodents. *Parasitology*, 35, 161-66.
- Radford, C. D. (1947). Parasitic mites from snakes and rodents. *Proc. Zool. Soc. Lond.*, 117, 228-40.
- Radford, C. D. (1950). The mites (Acarina) parasitic on mammals, birds and reptiles. *Parasitology*, 40, 366-94.
- Strandtmann, R. W. (1948). The Mesostigmatic nasal mites of birds. I. Two new genera from shore and marsh birds. *J. Parasit.*, 34, 505-14.
- Strandtmann, R. W. (1949). The blood-sucking mites of the genus *Haemolaelaps* (Acarina: Laelaptidae) in the United States. *J. Parasit.*, 35, 325-52.
- Turk, F. A. (1947). Studies of Acari. IV. A review of the lung mites of snakes. *Parasitology*, 38, 17-26.
- Vitzthum, H. Graf (1924). *Acarologische Beobachtungen. Liponyssus heterotarsus* n.sp. *Arch. Naturgesch.*, 90A, pt. 10.
- Vitzthum, H. Graf (1926). Malayische Acari. *Treubia*, 8, 1-198.
- Vitzthum, H. Graf (1935). Milben aus der Nasenhöhle von Vögeln. *J. Orn., Lpz.*, 83, 563-87.

- Vitzthum, H. Graf (1943). Acarina. In: *Bronn's Klassen und Ordnungen des Tierreiches*, 5, IV Abt., 5 Buch. (Leipzig: Becker u. Erler.)
- Zumpt, F. (1950 a). Some remarks on the family Laelaptidae (sensu Vitzthum 1943) with descriptions of three new species from African rodents. *Parasitology*, 40, 298-303.
- Zumpt, F. (1950 b). Records of some parasitic Acarina from Madagascar, with description of a new *Chiroptonyssus* species (Acarina, Parasitiformes. *Mem. Inst. Sci. Madagascar (A)*, 4, 165-73.
- Zumpt, F. (1950 c). Ectoparasites of bats from the Sterkfontein caves, Transvaal. *J. ent. Soc. S. Afr.*, 13, 87-98.
- Zumpt, F. (1950 d). A new blood-sucking mite from the South African springhare. *J. ent. Soc. S. Afr.*, 13, 83-86.
- Zumpt, F. (1951 a). Phylogenie der Zecken und "natürliches System". *Z. Parasitenk.* (In the Press.)
- Zumpt, F. (1951 b). Descriptions of two new Laelaps species from South Africa with a key to the Ethiopian species of this genus (Acarina: Laelaptidae). *S.Afr. J. Med. Sci.* (In the Press.)
- Zumpt, F., and Patterson, P. M. (1950). The Ethiopian species of *Hypoaspis* subgen. *Androlaelaps* Berlese (1903) with description of a new species. *S.Afr. J. Med. Sci.*, 15, 67-74.
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